

B-2-14 Installation of Ball Screw

B-2-14.1 Installation

Follow the flowchart in Figure 14.1 for installation procedures.

(1) Centering of the units

Align the centers of housings for the ball nut and the support bearing to which a ball screw is fixed. The centering is critical for life, smooth operation, and positioning accuracy of a ball screw.

We generally recommend the centering accuracy as follows for a precision grade ball screw.

- Inclination of center line: 1/2 000 or less (Target: 1/5 000 or less)
- Eccentricity: 0.020 mm or less

(2) Centering of ball nut housing

Photo 14.1 shows a centering procedure of the ball nut housing. Insert a jig (test bar) that has close fit clearance to a bore of the ball nut housing. Check vertical and horizontal parallelism of the test bar against the guide way (such as linear guides) with the dial indicator, that is fixed on the guide way bearing, and adjust the position of the housing so that the inclination of the center sets in 1/2 000 or less, and then, fix the housing to the table base.

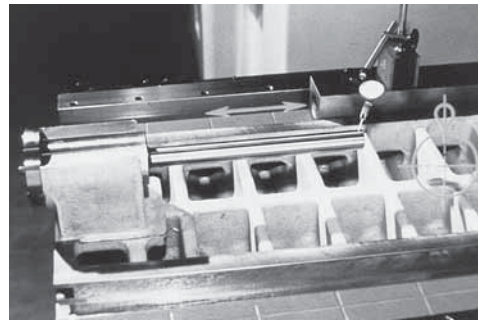


Photo 14.1 Centering of ball nut housing

(3) Centering of the housing of support bearing

Photo 14.2 shows a centering procedure of the housing of support bearing. As the same way of the ball nut housing, set the jig (test bar) that has close fit clearance to bore of the housing and adjust the position of the housing so that the aligning inclination sets in 1/2 000 or less, then fix the housing to the table temporarily.



Photo 14.2 Centering of the housing of support bearing

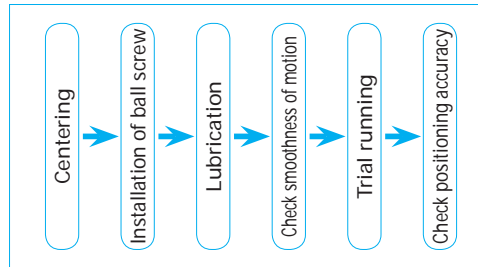


Fig. 14.1 Flowchart of ball screw installation

(4) Eccentricity of the housings

Measuring way of eccentricity between the two housings is shown in Figure 14.3. Set the table on the guide way (such as linear guides, etc), and fix a dial indicator on it. Check eccentricity of the test bar of support bearing housing against the test bar of ball nut housing. Adjust position of support unit housing so that the eccentricity gets in 0.020 mm or less, then fix the housing of support bearing.

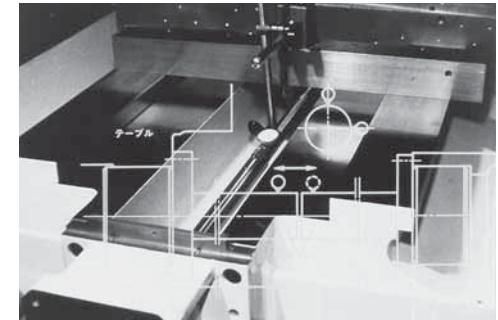


Photo 14.3 Eccentricity of the housings

(5) Installation of ball nut

Photo 14.4 shows a procedure for installation of the ball nut to the housing. Wipe off outside of the ball nut and bore of the housing with thin rags. (Applying a small amount of machine oil with low viscosity to both parts is effective in rust prevention.) Insert the ball nut to the housing while holding the ball screw in horizontal position and fix it. Do not handle the ball screw roughly, like hammering ends of the ball screw, because it may induce failure of the ball screw.

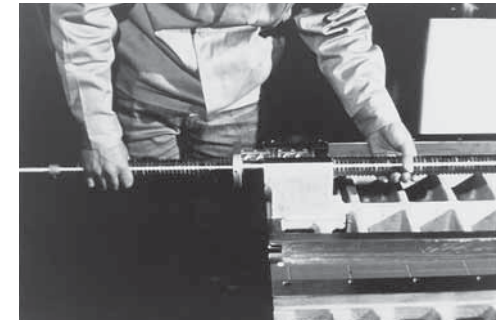


Photo 14.4 Installation of ball nut

(6) Installation of support bearings in ball screw

Photo 14.5 shows a procedure for installation of support bearings. Select bearings that have appropriate fitting tolerance to the screw shaft, then install them. We recommend using a special sleeve as shown in the photo not to apply impact to the bearings.

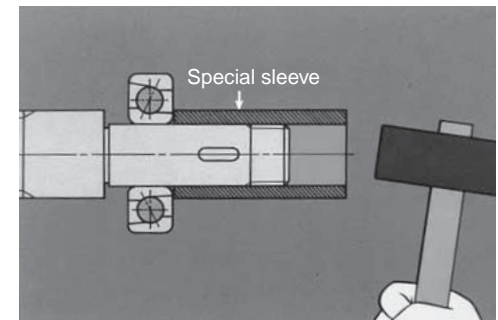


Photo 14.5 Installation of support bearings in ball screw

(7) Installation of bearings in the housing

Photo 14.6 shows the procedure for installing the support bearings to the bearing housing. When fixing the bearing with a lock nut, tighten the lock nut with specified tightening torque while checking run-out of screw shaft end. Take measures against loose lock nut. (Refer to assembly procedure of support bearing unit. Page B81)

For easy installation work of ball screws, NSK provides Support Unit (Page B433 to B452) that consists of bearings and Bearing Lock Nuts (Page B453) of which surface run-out is made to a specification.

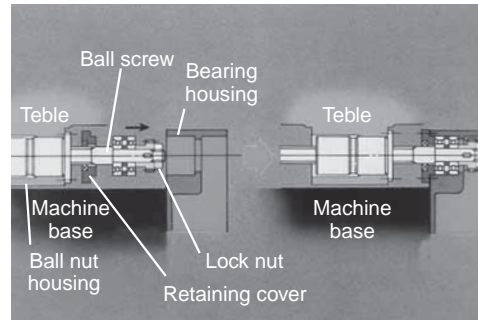


Photo 14.6 Installation of bearings

(8) Replenish lubrication grease

Photo 14.7 shows the replenishing procedure of lubrication grease. Applying grease prior to its operation is not necessary when the grease is packed into the ball nut. Please confirm it.

If grease is not used, we apply antirust oil to ball screws when shipping. Wipe off the oil and pack grease fully into the ball nut as shown in the photo.

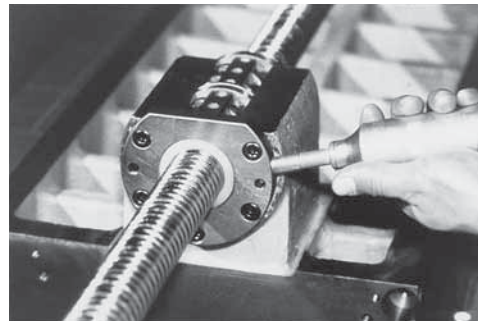


Photo 14.7 Replenish lubrication grease

(9) Check motion smoothness

Photo 14.8 shows a checking procedure for motion smoothness. This is to confirm if the table is assembled accurately. Use a torque wrench to measure starting torque of the ball screw for full stroke of the table. Check for abnormality in starting torque as well as unevenness of rotation by feeling.

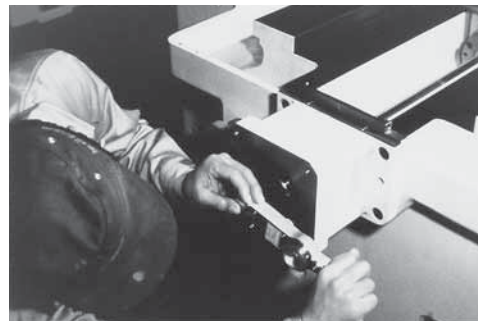


Photo 14.8 Check motion smoothness

(10) Trial operation

Photo 14.9 shows a seen of trial operation. Firstly operate the machine slowly and check noise and vibration, then do the same at medium and high speed. Operate the machine continuously for approximately 2 hours as a running in, and check for abnormality meanwhile. Remove over flown grease from the ball nut after a running in.

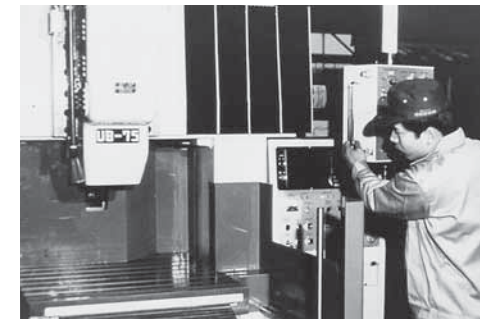


Photo 14.9 Trial operation

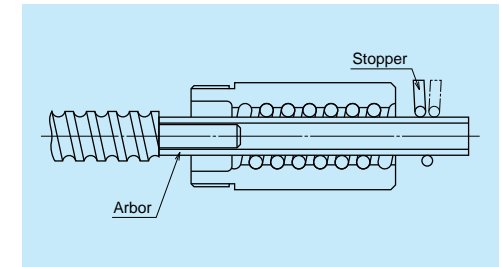


Fig. 14.2 Inserting nut into screwshaft

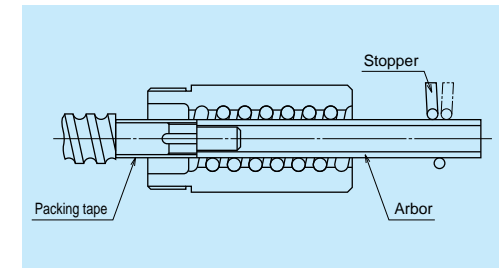


Fig. 14.3 Arbor and shaft end configuration

B-2-14.2 Inserting R Series Nut into Rolled Screw Shaft

When delivered, the nut of R series is separated from the screw shaft, and inserted into an arbor shaft. The nut must be inserted to the screw shaft when mounting ball screw.

(1) Consideration to end configuration of screw shaft

The balls may fall out during moving the assembled nut from the arbor to the screw shaft if the sizes and shapes of the arbor and the screw shaft are not appropriate. If the end of the ball groove can touch the end of the arbor, connect both ends and move the assembled nut from the arbor to the screw shaft (Fig. 14.2).

If the end face of the arbor cannot connect to the end face of the screw because of configuration of both ends of screw shaft, wrap a tape outside of ball screw shaft so that the layers of tape is

equal with the outside diameter of the arbor (Fig. 14.3).

If there is a key way or a nick along the way, fill such gaps prior to moving the ball nut.

(2) Installation of arbor

Confirm the correct nut orientation for installation. Remove the stop ring on the side from where the assembled nut is to be removed. Align the centers of the screw shaft and the arbor while pressing firmly the screw shaft end against the arbor.

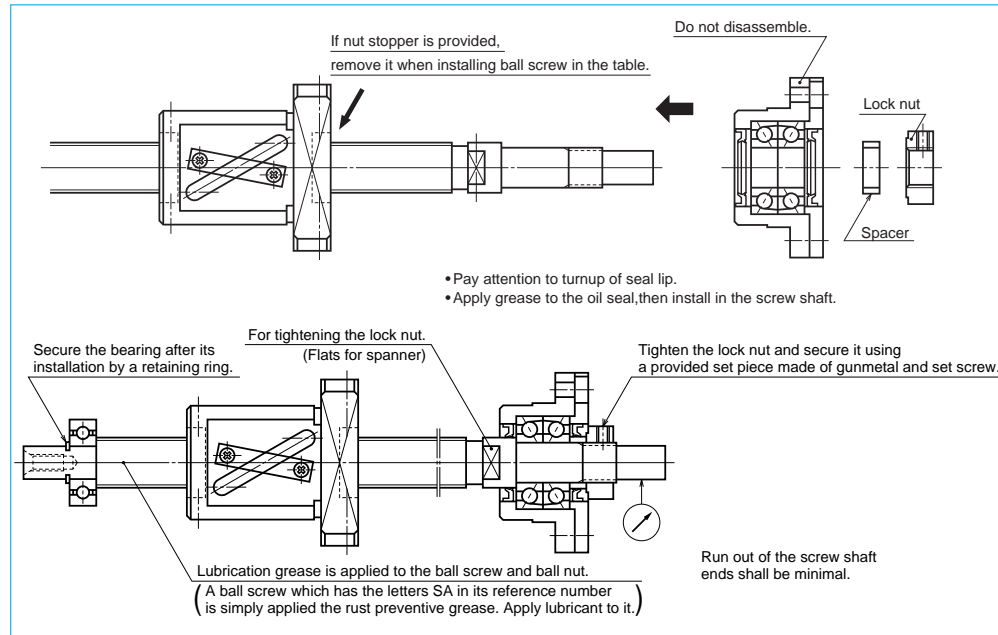
(3) Moving the nut

Slide the nut until it lightly touches the shoulder of the ball groove section, and stop it. Turn the ball nut to the direction so that it moves to the ball grooves, while pressing the arbor to the screw shaft. Do not separate the arbor from the screw shaft until the ball groove end appears completely in the ball nut.

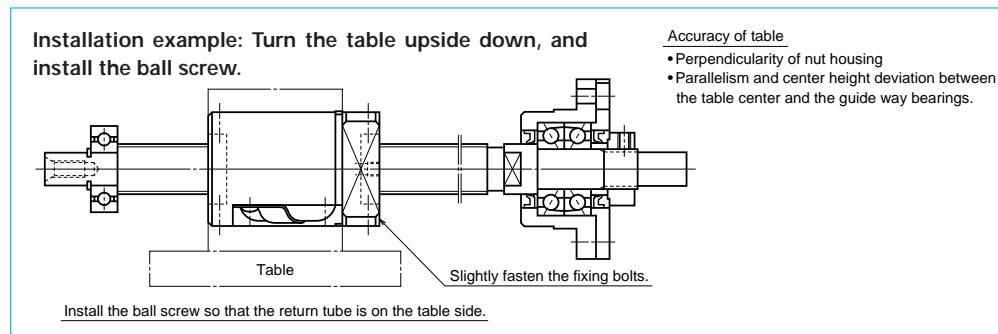
B-2-14.3 Installation of Ball Screw and Support Unit

The illustrations below show typical installation procedures of a standard ball screw and a support unit.

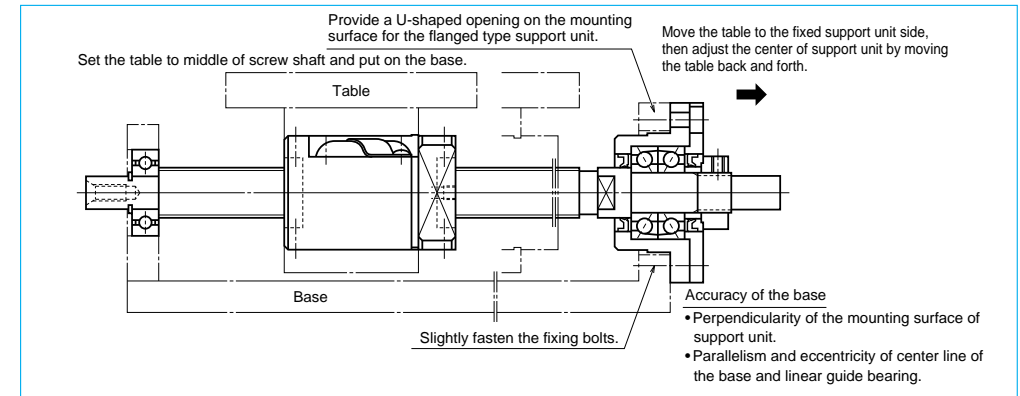
(1) Assembly of support unit



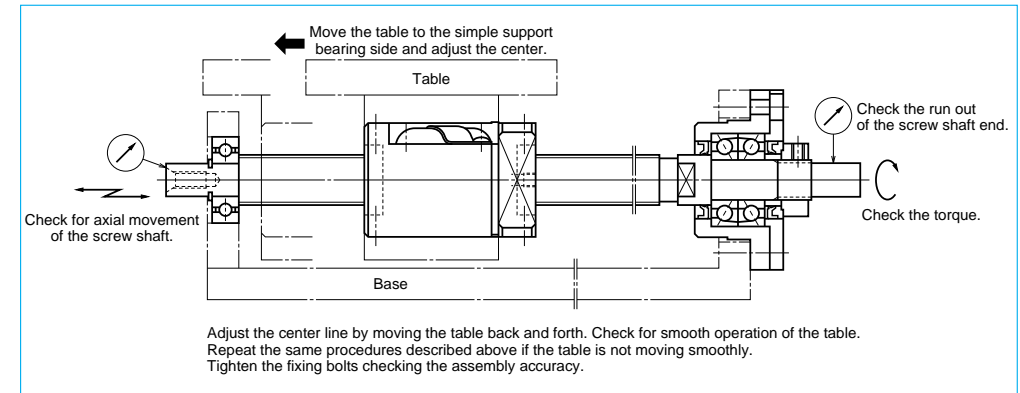
(2) Installation of ball nut to the table



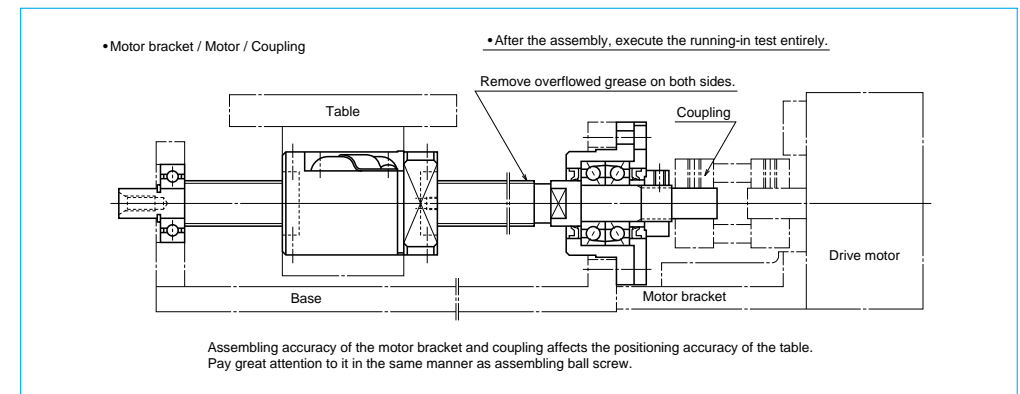
(3) Base and the support unit installation on the fixed support side



(4) Base and bearing installation on simple support side, and confirming assembling accuracy.



(5) Assembly completed.



B-2-14.4 Shaft End Machining

Shaft end is machined in the following three occasions.

- * Precision ball screws with blank shaft end.
- * Ball screws in R Series with blank shaft end.
- * Additional machining of a completed ball screw

The following are summaries of machining of these shaft ends. For details, please contact NSK.

(1) Additional machining of precision ball screw with blank shaft

① Cutting screw shaft

Use a cutting whetstone, etc. to cut the shaft, leaving stock for turning. Keep the nut in the assembled state to the screw shaft, and open only one side of the plastic wrapping bag, expose only the shaft end section to be machined, then cut the screw shaft. This prevents foreign matters from entering to the ball screw section. Do the same for other machining.

② Precautions in cutting shaft end

Outside of the screw shaft is ground with precision. There is a center hole in the ends. Use them for centering. Do not rotate the shaft quickly or stop it suddenly, or the nut might move along the shaft. We recommend securing the nut with tape. To machine a very long shaft, apply work rests to the screw shaft surface to suppress vibration (especially caused by critical speed).

③ Turning by lathe

Cut to the length, turn shaft end steps, turn thread screw, and provide the center hole. Refer to JIS B1192 which sets standards for shaft end accuracy.

④ Processing by grinding

Apply the same precautions as for cutting for centering, securing nut, and work rest. Grind sections where the bearings and a "Spann ring" are installed.

⑤ Milling processing

Process key way and lockwasher tooth seat.

⑥ Deburring, washing, rust prevention

Wash with clean white kerosene after processing. Apply lubricant for immediate use. For later use, apply rust preventive agent.

[Note]

Contact NSK if nut is accidentally removed.

(2) Additional machining of R Series ball screw shaft end

① Cutting screw shaft

Carry out the same process as for Precision ball screw with blank shaft above.

② Annealing the shaft end (Heat the section of the shaft end to be machined with an acetylene torch. Then gradually cool it in ambient atmosphere.)

* The area not machined loses hardness if exposed to heat. This shortens ball screw life. Cool with water the areas where should not be heated to avoid heat conduction.

③ The following process is the same as Precision ball screw with blank shaft above.

B-2-15 Precautions for Designing Ball Screw

B-2-15.1 Safety System

As shown in the illustration on Page B80, a stopper is installed in some cases to prevent the nut from overrunning due to malfunction of the safety system of the machine itself, or human error during operation.

The travel stopper should be installed at a place where it will not come into contact with the nut when the nut reaches the designed stroke end.

An impact absorbing travel stopper (NSK patent, refer to Page B456) is available at NSK.

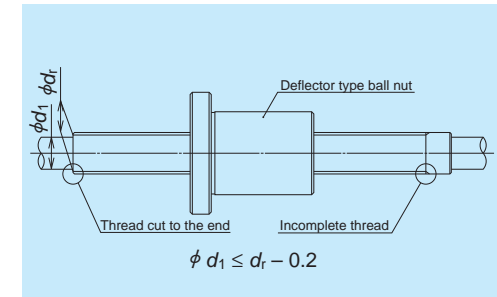


Fig. 15.1 Shaft end of a deflector recirculation system ball screw

B-2-15.2 Design Cautious to Assembling Ball Screw

(1) Cutting through the thread screw to the end

For the deflector, end cap and a part of end deflector ball recirculation system ball screws, one end of the thread screw should be cut through. This is for convenience of assembly for ball nut to the screw shaft (Fig. 15.1).

In this case, the shaft end diameter, where this thread cut through is made, should be 0.2 mm or smaller than the ball groove root diameter " d_r " (See the dimension table). A similar precaution is required when it is absolutely necessary to remove the nut from the screw shaft in order to install the ball screw to the machine. Also, in case using the cut-through end as the shoulder of the support bearing, make certain that a sufficient amount of the effective flat surface is left from the root diameter. If it is insufficient, the bearing cannot be installed in perpendicular to the bearing seat. (Fig. 15.2)

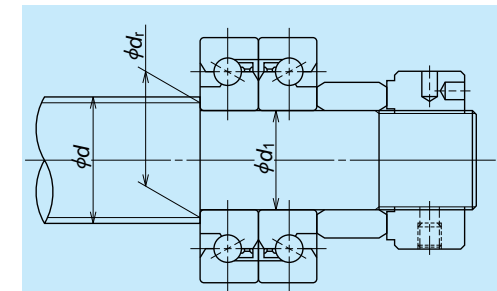


Fig. 15.2 Support bearing and end face (shoulder) for installation

(2) Designing screw shaft end and the nut area

When installing a ball screw to the machine, avoid a design which makes it necessary to separate the nut from the screw shaft as shown in Fig. 15.3. If separated, the balls may fall out. Separation may also deteriorate the ball screw accuracy, or may damage the ball screw. If separating them is unavoidable, please furnish NSK with the component which is to be installed between the nut and screw shaft. NSK will install the component prior to delivery.

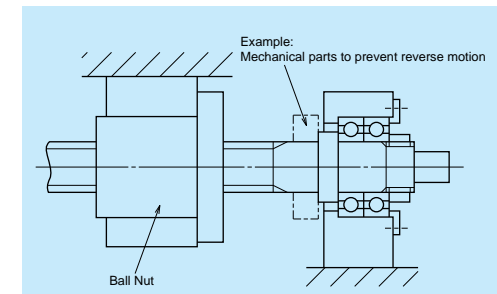


Fig. 15.3 Nut and ball screw are required to be separated when installing in this structure.